PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Methods of Forming the Outer Covering of Golf Balls and products thereof

I, LOUIS FERDINAND MUCCINO, a citizen of the United States of America, of Blind Brook Lodge, Rye, New York, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a golf ball and to a method of forming the outer covering of the golf ball.

Golf balls, as currently manufactured, sold and used usually comprise a central, spherical core on which a layer of rubber strand, either thread or tape, is wound under tension. The resulting wound core is usually referred to as a "center," and is also spherical in shape. The ball is completed by applying a cover to the center.

From the early days of the game of golf, balata and gutta percha have been the preferred materials for use in golf balls covers. Such materials are thermoplastic and are easily molded by application of heat and pressure, and even if used in unvulcanized condition are reasonably tough and resistant to damage. As the science of rubber technology has advanced, and as the demands of golf players for better covers have been made known, various improvements have been made. In some cases balata has been compounded with gutta percha, and in other cases balata or gutta percha or mixtures of the two have been compounded with rubber or various other ingredients believed to improve the characteriseics of the cover stock. In order to increase the toughness of the cover stock, it is now common practice to vulcanize or cure the covers, and improvements have also been made from time to time in vulcanizing and accelerating agents and in processes or procedures for vulcanizing or curing the covers.

In all cases, however, regardless of the nature of the cover stock, the method of applying the cover to the center has been substantially similar. That is, the selected cover stock has been warmed and molded to form hollow elliptical cups. The inside diameter of the cups has been somewhat less than the outside diameter of the center and the outside diameter of the cups has been somewhat less than the outside diameter of a finished ball. Two such cups have then been pressed onto opposite sides of a center, but without bringing the edges of the cups into contact. The assembled center and cups have then been placed between the hemispherical cavities of a mold which has then been placed in a hot plate press. As the cover stock was heated and softened by the heat of the mold, the mold parts were gradually brought together by the press to apply heat and pressure to cause the cover stock to flow. In doing so, the softened cover stock was forced into the interstices between the outer windings of the center and caused to adhere thereto. At the same time, the usual shallow depressions, commonly known as "dimples," have been formed in the outer surface of the cover by suitable protrusions projecting outwardly from the surfaces of the mold cavity.

The prolonged exposure to heat (temperatures in the region of 220° F. are commonly used) required to mold the cover stock onto the center and to vulcanize or partially vulcanize the cover has long been known to have a deleterious effect on the rubber windings of the center. It frequently causes breakage of the tensioned rubber strands, causes non-uniform compression, and is a serious source of rejects in the manufacturing process. Therefore, in order to reduce the duration of exposure to heat, the cover stock has been compounded with accelerators or with vulcanizing ingredients which are effective to produce vulcanization at normal room temperatures.

According to the present invention, there is provided a golf ball having a spherical center with an outside layer of rubber strand wound

under tension, said golf ball having an outer cover for said center, said outer cover consisting essentially of a cured urethane polymer.

According to the present invention, there is also provided a method of forming the outer covering of the golf ball of claim 1, comprising suspending said spherical center concentrically within a spherical mold cavity of a diameter greater than the diameter of the center so that a space of uniform thickness lies between the outside surface of the center and the inside surface of the cavity, injecting a liquid urethane polymer into said cavity in quantity at least sufficient to fill said space and at a pressure sufficient to cause said polymer to penetrate the interstices of the rubber windings of the center, retaining the covered ball in the mold until said polymer is set, and thereafter removing the covered ball from the mold and curing the polymer.

It has been discovered that liquid urethane polymers are admirably suited for use as a golf ball cover material, for not only can they be set and cured at normal room temperatures, or at moderate temperatures below the levels which have a substantial deleterious effect on the tensioned windings of the center, but also when applied to a golf ball center as hereinafter described form a strong, tough, resilient cover which is highly resistant to damage when the ball is struck by a golf club.

A specific example of such liquid urethane polymers is a product manufactured by E. I. du Pont de Nemours & Co. (Inc.) and sold under the Registered Trade Mark *Adiprene L.* It is described as a fully saturated urethane polymer of the polyether type which contains 4.0 to 4.3% of isocyanate groups, by weight. It is an odorless honey-colored liquid having a specific gravity of 1.06 and a viscosity of 14,000—19,000 cps at 86° F.

Such liquid urethane polymers may be cured by compounding them with curing agents such as diamines, polyols or catalysts known in the art, or merely by reaction with moisture in the air. They can be set and cured at normal room temperature or at elevated temperatures, the setting and curing times depending on the curing agent and temperature. For use in practicing the present invention, we prefer to cure at room temperature, or at temperatures below the point where deleterious effects on the tensioned rubber windings of the center begin to be observed. This point will vary somewhat, depending on the characteristics of the rubber and the tension applied thereto, but in general, temperatures in excess of 175° F. should be avoided at all times during the molding, setting and curing of the cover, for at temperatures above that point damage to the tensioned rubber is usually observed.

In the accompanying drawings:—

Figure 1 is a section through the mold on the line 1—1 of Figure 2.

Figure 2 is a plan view of one of the mold pieces.

Figure 3 is an enlarged fragmentary sectional view on the line 3—3 of Figure 2.

Referring to the drawings, the mold comprises two pieces 1 and 2, each having a hemispherical mold cavity 3, 4 formed therein. The diameter of each mold cavity is the desired outside diameter of the finished, covered ball, for example, 1.68 for conformance with the standards prescribed for tournament play in the United States. Each mold cavity is also provided with a multiplicity of small protrusions 5 of usual size and shape as required to form the usual "dimples" in the outside surface of the ball. Only a few of such protrusions are shown in the drawings by way of example, it being understood that such protrusions would be distributed over the spherical surfaces of the mold cavity in accordance with usual practice.

In addition to the protrusions 5, each mold cavity is provided with a plurality of small pins 6 which project radially from the surfaces of the cavity. Such pins are preferably conical in shape and are of a length adapted to suspend the wound center concentrically within the mold cavity so that a space 7 of uniform thickness lies between the wound center and the inside surface of the cavity. For example, assuming a cavity having a diameter of 1.68" and assuming that a center having a diameter of 1.62" is to be covered, the length of the pins should be slightly greater than .03", allowing for a slight degree of penetration due to the yield of the rubber windings.

The mold pieces 1 and 2 are also provided with inlet and outlet orifices 8 and 9, preferably located in each mold piece at diametrically opposed positions, as shown. A suitable injection nozzle (not shown) may be secured to the inlet orifice 8 for introducing the liquid covering material into the mold. The outlet orifice serves as a vent.

In covering a ball, a wound center 10 is placed in one of the mold pieces and the other mold piece is then placed in position to close the mold, the wound center being suspended concentrically within the spherical cavity by the pins 6 as described. The mold pieces are then locked together in any suitable manner. The liquid covering material is then injected into the mold in quantity at least sufficient to fill completely the space 7 and preferably in quantity sufficient to cause a slight excess to be exuded through the outlet orifice 9.

The liquid urethane polymer which is used as the covering material may be injected at normal room temperatures using pressures of from 150 to 200 p.s.i. to insure adequate penetration into the interstices of the rubber windings of the center. The mold, also at room temperature, is then allowed to stand until the covering material is set, after which the covered ball may be removed from the mold

and allowed to stand until the covering material is completely cured. The protrusions formed by the cover material in the inlet and outlet orifices 8 and 9 may then be trimmed off flush with the surface of the cover. The depressions formed by the pins 6 are so small as to be inconsequential. They are usually filled and concealed when the covered balls are painted in accordance with usual practice.

In view of the fact that setting and curing may be greatly facilitated by the addition of curing agents, we prefer to add such agents to the polymer before injecting it into the mold. Known curing agents such as diamianes, polyols or catalysts, for example, as recommended by the manufacturer (see Development Products Report No. 10, published by E. I. du Pont de Nemours & Co. (Inc.) dated March 15, 1958) may be used. In General, diamines are preferred as curing agents because they cure more rapidly and produce characteristics which are desirable in a golf ball cover, such as high tensile strength, to better advantage than other curing agents. Diamines such as MOCA (4,4¹ - Methylene-bis - 2 chloroaniline) and MDA (4,4¹-Diamine diphenylmethane) are satisfactory MOCA producing a relatively slow setting stock, while MDA produces a relatively fast setting stock.

Setting of the cover material may also be hastened by application of moderate temperatures below the level at which damage to the rubber windings begins to be observed, i.e. in the region below 175° F. Thus, if the mold is heated to 150° F., for example, and if the polymer is injected at 150° F., the required setting time may be considerably reduced without damaging the rubber windings. If the polymer is so heated, lower pressures may be used for injection. An injection pressure of approximately 25 p.s.i. will be sufficient, for example, at a temperature of 150° F. After the cover material is set and the ball has been removed from the mold, final curing may, if desired, also be hastened by application of moderate temperatures below the level of which damage to the rubber windings begins to be observed, i.e. the region below 175° F. Thus, after the covered balls have been removed from the mold, application of temperatures of 150° F. will greatly hasten curing without damaging the rubber windings.

It is very desirable that golf ball cover stock be white, because, even though it is universal practice in the industry to paint the cover with white paint, the paint coating frequently wears or chips off in normal use. If desired, therefore, the liquid urethane polymer, which is usually brown in color, may be whitened by the addition of a suitable white pigment such as titanium dioxide, for example. Twenty parts of titanium dioxide to one hundred parts of the polymer are sufficient to whiten the polymer.

It is also desirable to coat the mold surfaces with a suitable mold release in order to facilitate removal of the covered balls from the mold. Many mold releases are available in the commercial market, but we prefer to use a product manufactured by Peninsular Silicones, Inc. and sold under the designation MR—22, or a product manufactured by General Electric Co. and sold under the designation SR—53.

Specific examples of the practices of the method are as follows:

EXAMPLE 1

A wound golf ball center having a diameter of 1.62″ was placed in a mold as previously described.

The mold was at room temperature of approximately 75° F. The surfaces of the mold cavity were coated with the Peninsular Silicones, Inc. mold release known as MR—22. One hundred parts by weight of Registered Trade Mark Adiprene L were mixed with twenty parts of titanium dioxide and then mixed with eleven parts of a diamine curing agent referred to in the art as MOCA (4,4¹-Methylene-bis-(2-chloroaniline). Prior to mixture, the curing agent was heated to 223° F. to reduce it to liquid state. After mixture, the temperature of the mixture was 95° F. Immediately after the addition of the curing agent, the mixture was injected into the mold at a pressure of 200 p.s.i. The mold was allowed to stand for three hours, after which the covered ball was removed from the mold. Thereafter it was allowed to cure at room temperature for two weeks. The cover was then observed to be strong and tough and highly resistant to damage by impact with a golf club.

EXAMPLE II

The procedure of Example I was followed except that the mold was heated to a temperature of 150° F. and the polymer mixture was also heated to a temperature of 150° F. After injection of the heated mixture at a pressure of 25 p.s.i. the mold was allowed to stand for forty minutes. Thereafter the covered ball was removed from the mold and cured by subjecting it to a temperature of 150° F. for eight hours. The characteristics of the cover were similar to those of Example I. Examination of the rubber windings of the center failed to show any evidence of damage from the applied heat.

EXAMPLE III

A wound golf ball center having a diameter of 1.62″ was placed in a mold as previously described. The mold was at room temperature of approximately 75° F. One hundred parts of Adiprene L was mixed with twenty parts of titanium dioxide and then mixed with eight parts of a diamine curing agent referred to in the art as MDA (4,4¹-Diamino diphenyimethane). Immediately after the addition of the curing agent, the mixture was injected into the mold at room temperature

at a pressure of 200 p.s.i. The mold was allowed to stand for five minutes, after which the covered ball was removed from the mold. Thereafter it was allowed to cure at room temperature for two weeks. The characteristics of the cover were similar to those of Example I.

EXAMPLE IV

The procedure of Example III was followed except that the mold was heated to a temperature of 150° F. The polymer mixture was at room temperature. After injection of the polymer at a pressure of 200 p.s.i. the mold was allowed to stand for two minutes. Thereafter the covered ball was removed from the mold and cured by subjecting it to a temperature of 150° F. for five hours. The characteristics of the cover were similar to those of Example I.

It will be understood that the method of the invention may be used to advantage even though temperatures above 175° F. are used to hasten setting or curing or both. If temperatures above 175° F. are used, the tough, damage resistant qualities of the cover are retained, even though the rubber windings of the center may be damaged to some extent, the extent of the damage depending on the temperature used and the duration of exposure thereto. Golf balls covered by the present method, however, and utilising temperatures below 175° F. exhibit superior performance characteristics because of the undamaged condition of the rubber windings.

It is understood that the invention may be variously modified and embodied within the scope of the subjoined claims.

WHAT I CLAIM IS:—

1. A golf ball having a spherical centre with an outside layer of rubber strand wound under tension, said golf ball having an outer cover for said centre, said outer cover consisting essentially of a cured urethane polymer.

2. A golf ball according to claim 1, wherein the cover is obtained from curing the urethane in the liquid form.

3. A golf ball according to claim 1 or 2, wherein the urethane has been set and cured at a temperature less than 175° F.

4. A golf ball according to claim 1, 2 or 3, wherein the urethane polymer is a fully saturated urethane polymer of the polyether type containing 4.0 to 4.3% of isocyanate groups, by weight.

5. A method of forming the outer covering of the golf ball of claim 1, comprising suspending said spherical centre concentrically within a spherical mold cavity of a diameter greater than the diameter of the centre so that a space of uniform thickness lies between the outside surface of the centre and the inside surface of cavity, injecting a liquid urethane polymer into said cavity in quantity at least sufficient to fill said space and at a pressure sufficient to cause said polymer to penetrate the interstices of the rubber windings of the centre, retaining the covered ball in the mold until said polymer is set, and thereafter removing the covered ball from the mold and curing the polymer.

6. A method according to claim 5, wherein said mold is maintained at a temperature not exceeding 175° F.

7. A method according to claim 5 or 6, wherein said polymer is injected into said mold at a temperature not exceeding 175° F.

8. A method according to claim 5, 6 or 7, wherein after removal of the covered ball from the mold, the cover is cured at normal room temperature.

9. A method according to any of claims 5—8, wherein after removal of the covered ball from the mold, the cover is cured at a temperature not exceeding 175° F.

10. A method according to any of claims 5—9, wherein said spherical centre is suspended on a plurality of pins projecting radially from the spherical surface of said mold cavity.

11. The method of forming the outer covering of a golf ball substantially as hereinbefore described.

12. The golf ball substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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869490 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1

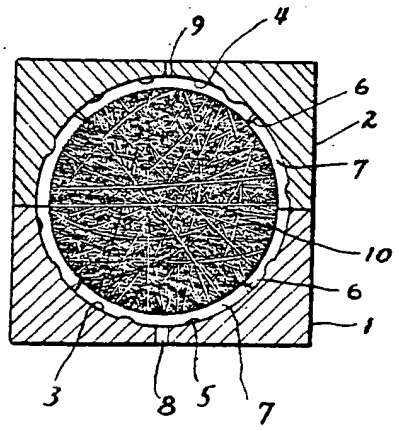

Fig. 2

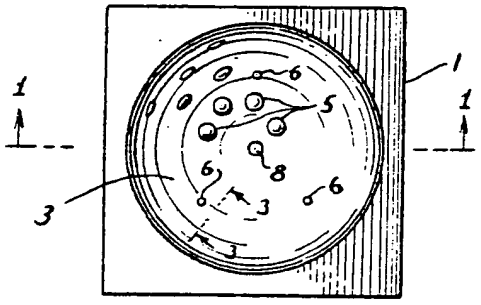

Fig. 3